



# NSF MPS/AST

Committee on Astronomy &  
Astrophysics

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Jim Ulvestad  
Division Director, MPS/AST



# Outline

- AST science and tools
- Budget outlook and Astro2010
- Portfolio review



# Takeaway message

Ground-based astronomy is very healthy, with significant new capabilities coming on line this decade (many from previous decadal surveys), with new discovery opportunities. However, budget constraints mean that starting any new initiatives, and maintaining a healthy community, will require tough priority choices and divestiture of some unique capabilities. Without making these choices, little or no progress will be made on Astro2010 recommendations.



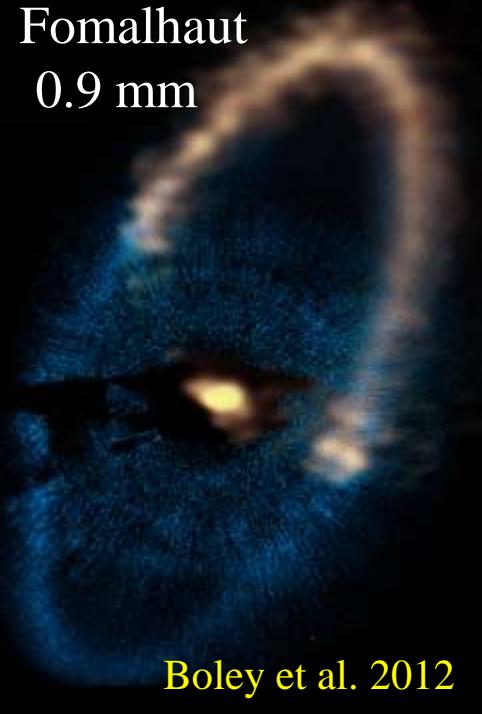
# 2011 Nobel Prize in Physics

- Discovery of accelerating universe/Dark Energy
  - Saul Perlmutter, Adam Riess, Brian Schmidt
- Numerous AST individual investigator grants to Bob Kirshner at Michigan and Harvard in 80s/90s
  - Various other grants to co-investigators
- NSF Center for Astroparticle Physics, UC Berkeley
- Key supernova discoveries and follow-up at Blanco 4m telescope in Chile (NOAO/CTIO)
  - NOAO scientific staff were key part of collaboration
  - Follow-up/support at KPNO, Gemini, Keck
- HST was also integral to discovery and follow-up



# ALMA

- Early science started in September
  - 112 projects selected from over 900 Cycle 0 proposals; first papers published
  - Cycle 1 proposal deadline in mid-July
- 62/66 antennas in Chile; 42 accepted
- Final North American deliverables on course for late 2012 completion
- Inauguration in 2013

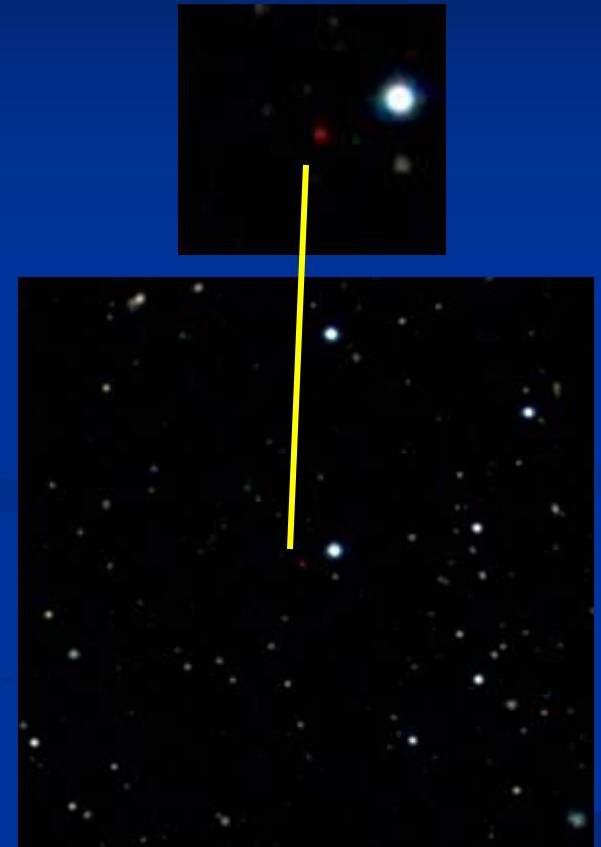
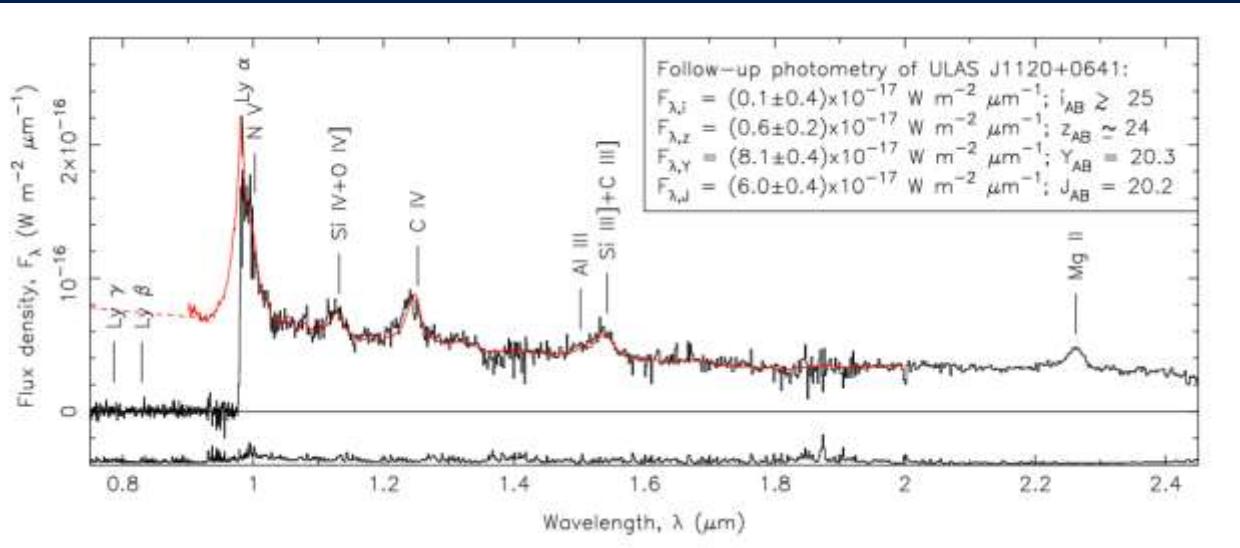




# ALMA



# Gemini Quasar at $z=7.1$



- GNIRS + VLT spectrum of most distant QSO yet discovered. Massive black holes existed when universe was 750 MY old. IR-optimized Gemini was key to this discovery.

Mortlock et al. 2011, Nature, 474, 616

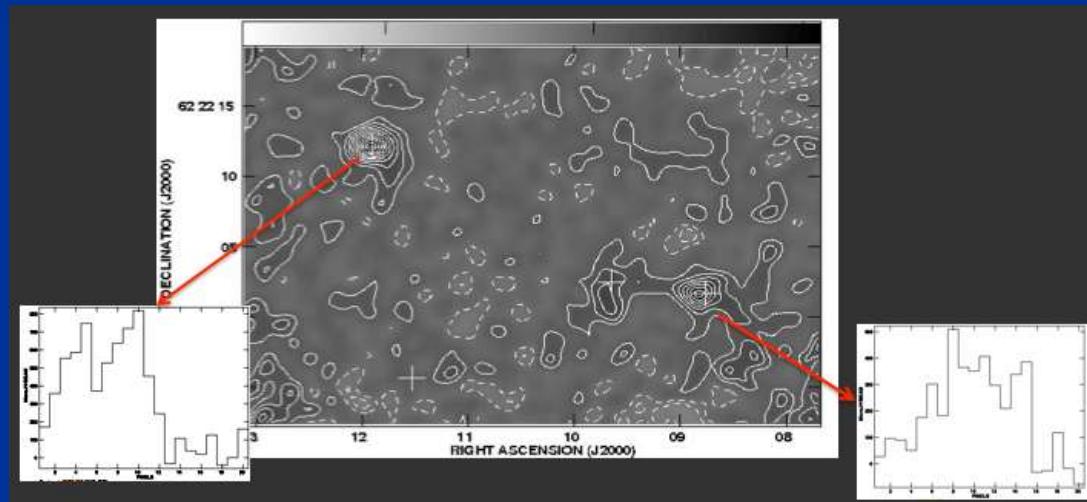
QSO is the red object in the center of the frame.



# EVLA: Forming Cluster in Early Universe

- EVLA finds  $10^{10}$ - $10^{11}$   $M_{\text{sun}}$  of gas from CO observations of 3 galaxies at  $z=4.05$
- 34 papers with first EVLA science in ApJL special issue, September 2011
- EVLA re-dedicated as Karl G. Jansky VLA on March 31, 2012; capabilities growing

2" size, apparent ordered rotation

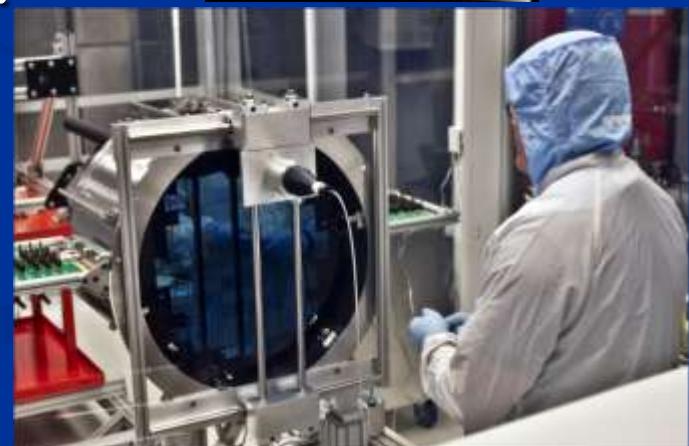


Carilli et al. 2011, ApJ, 739, L33



# Dark Energy Survey

- Probe dark energy using 4 methods
  - Photo-z, shapes for 300 million galaxies
  - 4000 SNe 1A to  $z \sim 1$
- 570 megapixel optical/NIR camera with 3 sq. deg. FOV and 5-element optical corrector, to be mounted on CTIO Blanco 4m telescope
- DECam from Fermilab/DOE, data management and CTIO ops from NSF and NOAO
- First light in Sept 2012
- 5-yr survey commences Nov. 2012





# ATST—Completion 2019

## Improvements over current state of the art:

- Resolution –  $\sim 3X$  improvement
- Light grasp –  $\sim 8X$  improvement (solar physics is actually photon starved in some experiments)

## Technical Specifications:

- 4-m, off-axis Gregorian (all reflective), alt-az mount.
- Integrated adaptive optics.
- Hybrid enclosure with thermal control and dust mitigation.
- Wavelength sensitivity from 0.3-28 microns (near-UV through thermal infrared).
- Field of view: 3 arcminutes.
- Angular resolution  $< 0.03$  arcsecond.
- Polarization accuracy  $< 0.01\%$ .

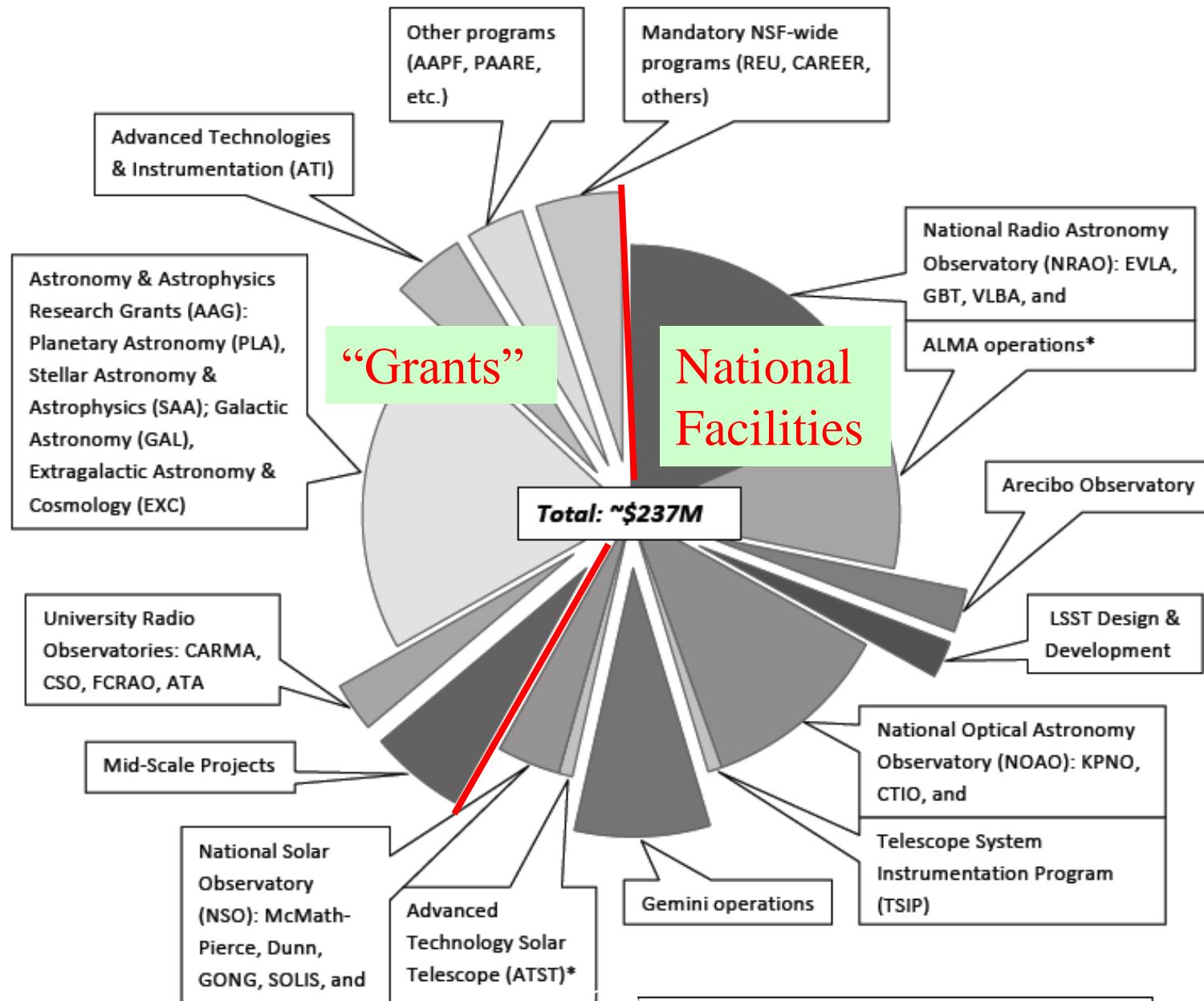
\$300M construction budget from MREFC  
Presently awaiting resolution of final construction appeal in Hawaii  
Slipping 1 day per day while awaiting permit





# Budget Outlook & Astro2010

# A Snapshot of the AST Portfolio in FY 2011





# NSF Budget FY 2013

- President's budget request for NSF was \$7.37B, an increase of \$340M (4.8%) relative to FY 2012
- Initial markups by House and Senate committees give respective increases of \$299M and \$240M, about 4%.
  - Impact of election and deficit-reduction efforts are presently unknown and unpredictable
  - Senate appropriators have delivered many instructions regarding NSF astronomy program



# NSF Budget FY 2013

NSF & AST	NSF R&RA	%/prior yr	AST	%/prior
FY10 Approp.	\$5.62B	+9.1%	\$246.5M	+8%
FY11 Request	\$6.02B	+7.1%	\$251.8M	+2%
FY11 Approp.	\$5.61B	-0.2%	\$236.8M	-4%
FY12 Request	\$6.25B	+12.4%	\$249.1M	+5%
FY12 Approp.	\$5.69B	+1.4%	\$234.5M	-1%
FY13 Request	\$5.98B	+5.2%	\$244.5M	+4%

- \$10M increase for AST in FY13 request includes increase of \$9M for EARS (Enhancing Access to the Radio Spectrum), from \$3M to \$12M, connected to the President's Broadband Initiative
- Each of AST FY11/12 appropriations was \$15M below request
  - Even at full request level, AST budget will be less than FY 2010
- See March-April AAS newsletter for more commentary



# Some Details of FY12/13 Budgets

- FY12 plan
  - Research grants (AAG) cut from \$49M to \$43M
    - Expect success rate ~13% (20% in FY11)
  - NOAO cut from \$27.5M to \$26M
  - Gemini increased \$1.5M due to Congressional mandate
  - ALMA operations ramp reduced
  - University Radio Observatories cut significantly; no TSIP
- FY13 budget request
  - Significant reductions in NRAO, Gemini, NSO
  - NOAO stays at lower level
  - Significant constraints in Senate Appropriations language
    - Difficult to take action based on FY13 plans

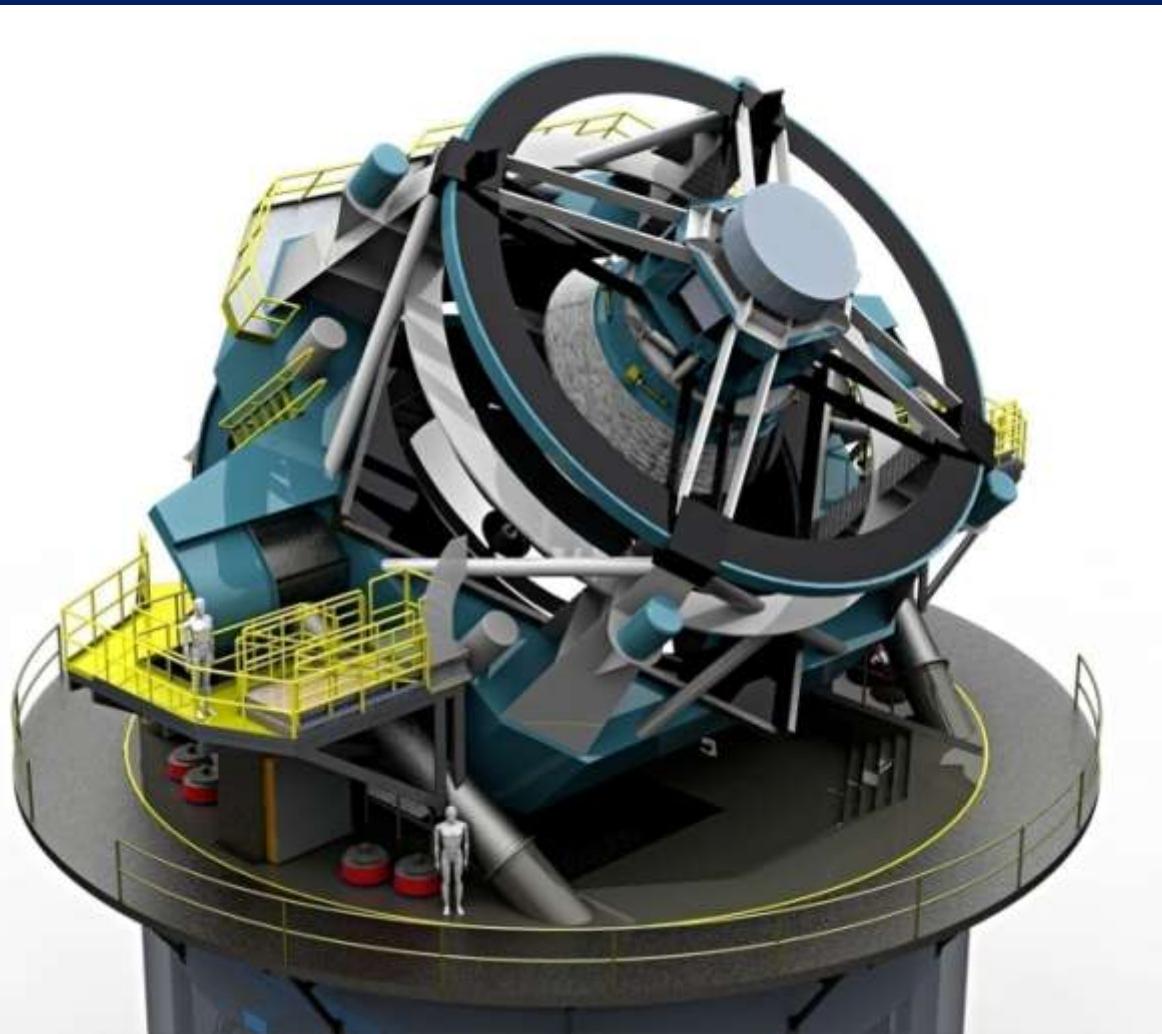


# Budget Compared to Astro2010

- Astro2010 report assumed budget doubling from 2010 to 2020 (to ~\$493M in FY20, assuming ~3% inflation)
  - Would have resulted in FY13 AST budget of \$303.5M
  - FY13 President's request for AST is \$244.5M including \$12M for EARS
    - \$60M-\$70M below Astro2010 assumption, in best case
- In January 2012 letter, AST advised community to expect budget between \$245M and \$340M in FY20
  - Achieving \$340M would require passage of FY13 budget request and 5%/yr increase until FY20
  - Serious modification of expectations and of current portfolio will be required in order to respond to any Astro2010 recommendations



# Large Synoptic Survey Telescope



- 8.4 meter primary mirror
- 3.3 gigapixel digital camera
- 3.5 deg field of view
- 30 terabytes of data nightly
- Complete coverage of the visible sky twice per week
- Nominal 10-yr lifetime
- To be located on Cerro Pachon, Chile

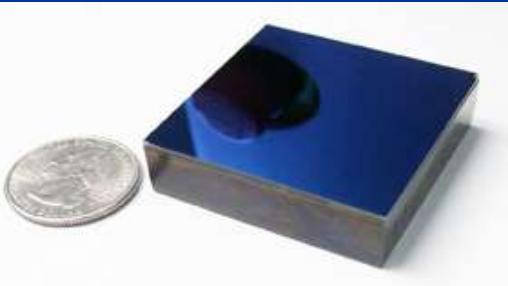
- Site, telescope, and data handling to be funded by NSF
- Camera funding by DOE (SLAC is lead laboratory)
- Cost estimate \$665M in then-year dollars (\$466M NSF, \$160M DOE, \$39M private)
- Aiming for FY14 construction start



# LSST Technical Progress



- ❖ M2 substrate completed and in storage



- ❖ Fabrication of M1/M3 mirrors: final abrasive grinding, then polishing – complete by end of CY2012



- ❖ Two vendors have fabricated fully-operable prototype sensors that meet the major specifications.



- ❖ Site leveling completed





# LSST Review Status

- NSF Preliminary Design Review held Aug. 29-Sept. 2
  - “The Panel considers that the LSST Project has met the requirements for PDR
- DOE CD-1 “Lehman” review of Camera, Nov. 1-3
  - The Project met all the CD-1 requirements “and in some areas has even significantly exceeded them”
- Subsequent NSF MREFC panel recommendations
  - Align NSF and DOE funding profiles (done)
  - Review cost updates, interfaces between NSF and DOE parts of project, science impacts of engineering performance deltas
    - All completed in May/June
  - Also need completed NSF/DOE MOU
- Proposal for FY14 start is just possible



# Other Astro2010-Large

- Mid-scale Innovations Program (MSIP)
  - No new starts for unsolicited midscales in FY 12
  - Drafted plan, but no funding available in near-term
  - Astro2010 recommendation mixed instrumentation, experiments, and facilities, some fairly expensive
  - Funding medium-class facilities could involve multi-decade operations commitments
- Giant Segmented Mirror Telescope (GSMT)
  - No construction funding until at least 2020, if then
  - Solicitation issued for partnership planning; proposal review under way
- ACTA: No current plans, might compete via MSIP proposal if a funding line existed



# Other Astro2010-Small

- CCAT
  - Funding Design & Development through FY13
  - No construction wedge apparent
  - Carries same long-term operations concerns as medium facilities that might be funded in MSIP
- Small recommendations
  - Cutting research and instrumentation grants due to budget necessities
  - Working with NASA on starting Theory/Comp Network
  - Gemini increase in FY12 mandated by Congress
  - TSIP likely to be re-worked, if resumed



# Portfolio Review



# Why Conduct a Portfolio Review?

- Foreseeable budgets will not be sufficient to meet the aspirations of the astronomical community
- NRC decadal survey in Astronomy & Astrophysics advised: “If ... budget is truly flat ... there is no possibility of implementing ... the recommended program ... without ... enacting the recommendations of the first 2006 senior review and/or ... a second more drastic ... review before mid-decade.” (p. 240)
- Such reviews should be carried out periodically in any case, for responsible stewardship of the AST portfolio



# Over-riding Goal

- Position ground-based astronomical research in the US for success in 2020 and beyond
- Look to the future of scientific advances and our community under a more constrained budget environment



# Starting Points: Decadal Surveys

- ***New Worlds, New Horizons*** Chapter 2 (Science Frontiers questions) and ***Vision and Voyages*** Chapter 3 are the driving forces
- Boundary conditions: No re-visiting the ordering of decadal survey recommendations, and no re-visiting of their science priorities
  - I.e., take decadal surveys as a “given”, and interleave their recommendations with existing capabilities
- “Capabilities” includes facilities, programs (including grants), and state of the profession
- External committee of 17 scientists
  - Chaired by Daniel Eisenstein of Harvard



# Two-Phase Committee Charge

1. Recommend the *critical capabilities* needed over the period from 2015 to 2025 that would enable progress on the science program articulated in the Astronomy & Astrophysics and Planetary Decadal Surveys. (Not only observational capabilities, but also theoretical, computational, laboratory, research support, workforce, education)
2. Recommend the *balance of investments* in new and in existing, but evolved, facilities, grants programs, and other activities that would deliver the needed capabilities within the constraints of each of the provided budgetary scenarios. (May include closure or divestment of facilities, termination of programs and other activities.)



# Portfolio Review Timeline

- September 2011: Start
- January 2012: Completed first pass at Phase 1
- April 2012: 3<sup>rd</sup> of 3 face-to-face meetings
- July 2012: Final draft report submitted to NSF
- Late summer: MPS Advisory Committee vote to accept
  - Report becomes public at this point
  - Rollout plan under development
- November 2012: AST implementation plan released
  - Plan will be a living document, evolving over years
- Recommendations and implementation will have profound impact on ground-based astronomy in next decade